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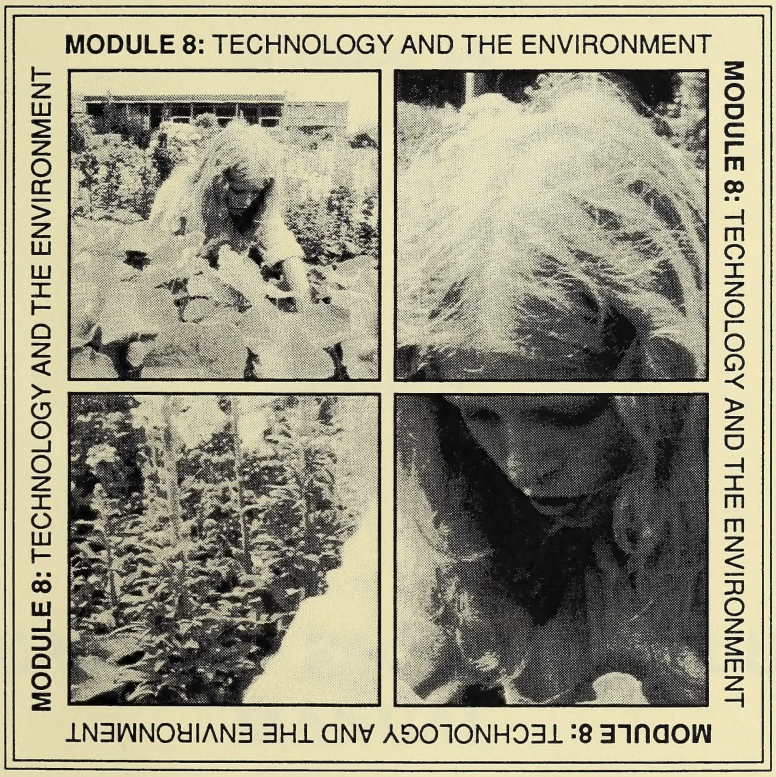
MODULE 8: TECHNOLOGY AND THE ENVIRONMENT
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Learning Facilitator's Manual

Distance Learning

Alberta EDUCATION

Science 14

Module 8

LEARNING FACILITATOR'S MANUAL

Note

This Science Learning Facilitator's Manual contains answers to teacher-assessed assignments; therefore, it should be kept secure by the teacher. Students should not have access to these assignments until they are assigned in a supervised situation. The answers should be stored securely by the teacher at all times.

Science 14
Learning Facilitator's Manual
Module 8
Technology and the Environment
Alberta Distance Learning Centre
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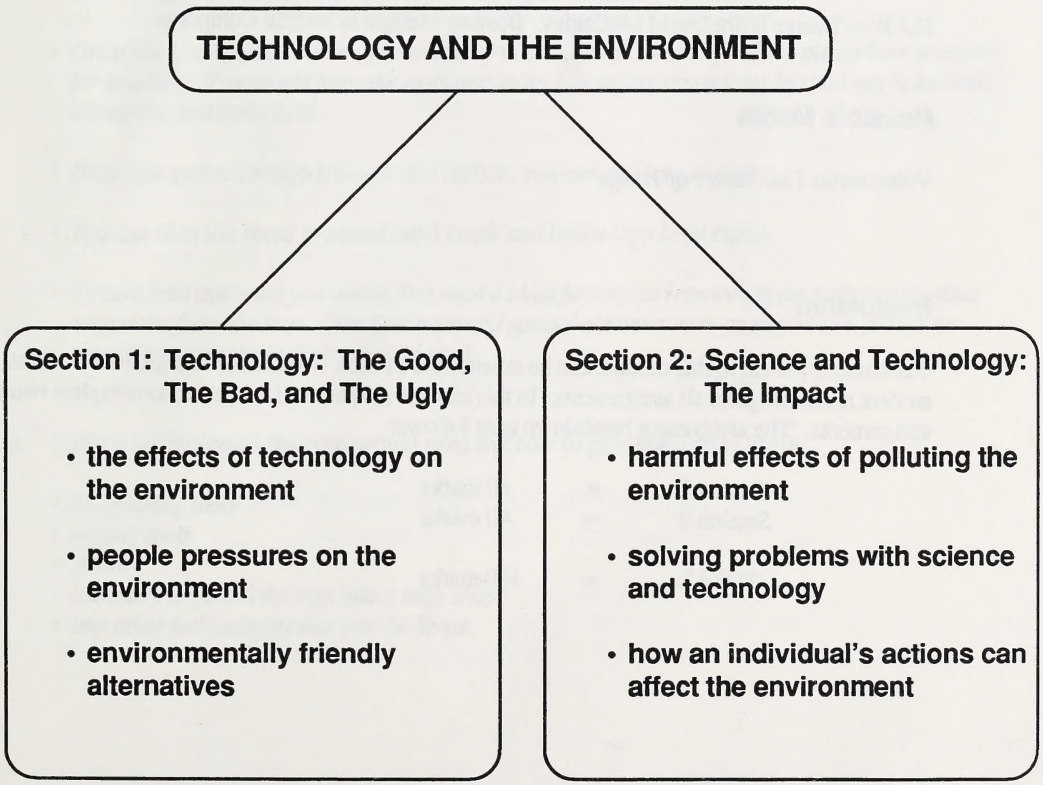
Module 8 – Technology and the Environment: Overview

The emphasis of this module is on having the students understand that

- science and technology have an effect on the environment
- society can influence science and technology
- society can affect the quality of the environment
- the effects of science and technology on society and the environment are sometimes unforeseen

The students are expected to learn that they are members of society and that they can have some control over the direction and effects of science and technology. The purpose of this module is to help the students become caring members of society who will make good decisions for both society and the environment.


TECHNOLOGY AND THE ENVIRONMENT
Section 1: Technology: The Good, The Bad, and The Ugly
• the effects of technology on the environment
• people pressures on the environment
• environmentally friendly alternatives
Section 2: Science and Technology: The Impact
• harmful effects of polluting the environment
• solving problems with science and technology
• how an individual's actions can affect the environment

Materials You Need

There are no investigations in this module which require materials.

Additional Resources

GAIA: An Atlas of Planet Management Dr. Norman Meyers, ed. Garden City, New York: Anchor Press/ Doubleday & Co. Inc., 1984.

Green Future: How to Make a World of Difference Lorraine Johnson. Markham, Ontario: Penguin Books, 1990.

Living in the Environment 6th Edition G. Tyler Miller Jr. Belmont, California: Wadsworth Publishing Company, 1990.

Two Minutes a Day for a Greener Planet Marjorie Lamb. Toronto: Harper Collins Publishers Ltd. 1990.

The Way Things Work David MaCauley. Boston: Houghton Mifflin Company.

Possible Media

Video series *The Nature of Things*

Evaluation

The student's mark in this module can be determined by their work in the Assignment Booklet. Each student must complete all assignments. In this module the student is expected to complete two section assignments. The assignment breakdown is as follows:

Section 1	=	60 marks
Section 2	=	40 marks
TOTAL	=	100 marks

Section 1: Technology: The Good, the Bad, and the Ugly

This section examines a variety of technologies and their effects on the environment. The focus is often on the students who, as members of society, are really the driving force behind most technology. There is an ongoing effort to expand the students' awareness of their personal effect on the environment. Also included are some positive notes about science and technology.

Section 1: Activity 1

Investigation: Is Knowledge Enough?

1. Outline the steps and procedures you would take in order to make a steel knife.

   - *You will first have to find some high-quality iron ore. Since you lack any digging tools or analytical equipment, the ore will have to be found on the surface of the land.*
   - *Once you find some iron ore, you will have to build something in which to smelt the ore. This will be very difficult since you have no tools with which to build the smelter.*
   - *Once you construct a smelter, you will have to cut enough trees to produce the carbon necessary for smelting. You do not have the tools necessary for cutting down trees but you might be lucky enough to find some coal.*
   - *Once you gather enough iron ore and carbon, you can smelt some iron.*
   - *You can then use rocks to pound out a crude and brittle iron knife blade.*
   - *To turn iron into steel you would first need a blast furnace to remove excess carbon and other impurities from the iron. Then you must add special elements such as chromium, nickel, or tungsten to turn the molten iron into steel.*

2. List the technologies that you would need in order to produce a steel knife.

   - *tree-cutting tools*
   - *mining tools*
   - *smelter*
   - *hammers to pound the iron into a knife shape*
   - *any other technologies that may be listed*

3. Explain why some people remained in the Stone Age, even though Europe and some parts of Asia and Africa had moved into the Iron Age.

   People in Europe, Asia, and some parts of Africa had developed the technologies to produce steel. They had also developed the technologies necessary to transport the raw materials, finished products, and labour. This process of development took a long time. People that did not develop the technologies necessary to get out of the Stone Age suddenly found themselves confronted by people with superior technology. Since these Stone Age people could not make these products, they bought them using raw materials as payment.

4. a. List the products that you think are being produced as a result of the activity shown.

   The airplane is dusting a crop of some kind, so you would be producing either vegetables, grain, or fruit.

   b. List the things that this activity is doing to damage the environment.

   The spray is used to control either insects or weeds. There are many problems associated with spraying this way. Many other insects or plants will be killed. The spray may be long-lived and get into the ground water. There are other things to consider. How much harm is done to the environment through the production of the airplane, the fuel and lubricants, and the spray being used?

   c. How could the products of this activity be produced less expensively and with less harm to the environment?

   In order for the product to be produced less expensively, somebody has to do their job for less money.

   - *The farmer might be asked to sell his crop for less money.*
   - *The airplane pilot might be asked to spray the crop for less money.*
   - *The companies that produce the airplane, fuel and lubricants, and chemical spray might be asked to manufacture their products for less money.*
   - *The farmer might be asked not to use any spray, even though the crop might be ruined.*

   You might also have argued that if everybody involved was to work more efficiently the cost of the product would be reduced.

5. a. List the products that you think are being produced as a result of the activity shown.

   Wood products are being produced. This can include lumber, paper, and a variety of processed wood products.

b. List the things that this activity is doing to damage the environment.

The clear-cutting of a forest destroys wildlife habitat and displaces the organisms which were living in the forest. The technology related to the forest industry is polluting and damaging the environment (i.e. the bulldozer, the fuel burned, the pulp mills, the paper mills, and the lumber mills).

c. How could these products of this activity be produced less expensively and with less harm to the environment?

The main reason for clear-cutting is economics. The consumer demands high-quality wood products but wants them to be inexpensive. Selective cutting is less harmful to the environment but is more expensive. Any attempt to reduce the pollution from pulp, paper, and lumber mills will result in increased costs to the consumer. Labour costs could be reduced to make a less expensive product.

6. Damage to the ozone layer has caused the makers of aerosol sprays to stop using CFCs. Examine various aerosol products in your home or at the store and explain two ways that industry has solved this problem.

Industry has used technology to develop environmentally safe propellants. These are gases which will not harm the ozone layer. Sprays are also available with an aerosol pump. The consumer pushes down on a mechanical pump to create a spray.

7. Give two environmentally friendly alternatives to using common dry cell batteries in your electronic devices.

Instead of using common dry cell batteries you could

- *use rechargable batteries*
- *use an AC adaptor to plug your electronic device into household current*

All these alternatives will reduce the number of dry cell batteries that would be discarded into a landfill site.

8. Pregnant woman in some areas are advised against breast feeding their newborn children because their milk contains high concentrations of DDT. Briefly explain how DDT must have got into the milk?

DDT is a fat-soluble chemical which is stored in the body fat of living organisms. Plant-eating animals, such as cows, eat plant material with small amounts of DDT. The DDT becomes concentrated in the cows and in the cow's milk. Humans drink milk and eat cows and calves. Both of these foods contain DDT which becomes concentrated and passed on in mother's milk.

9. Why do you think the ban on leaded gasoline is beneficial to the environment?

   The burning of leaded gasoline releases lead into the air. This lead enters your body when you breathe in polluted air. It becomes concentrated in your body tissues and can cause damage to the brain and nervous system, increase blood pressure, and increase your risk of heart attack.

10. Explain the harmful effects that a product such as a VCR has on the environment. Why is this hard to do?

    This is hard to do because a VCR does not seem to produce any harmful wastes. But the technologies that produce the VCR, the video tapes, and the power that is needed to run it all produce nonbiodegradable wastes. You could also include the television, transportation, and marketing technologies as contributing to the production of nonbiodegradable wastes. Finally, the VCR itself gets thrown out when it becomes outdated.

11. Who is ultimately responsible for recycling nonbiodegradable wastes?

    Society, the individual industries, and the government are responsible for recycling nonbiodegradable wastes.

12. How does nature deal with biodegradable wastes?

    Nature recycles biodegradable wastes.

13. What are the main problems that society and nature have with **synthetic** chemicals?

    Synthetic chemicals can pose problems for nature and society because they are often

    - *nonbiodegradable*
    - *may be very poisonous or harmful to your health*
    - *may take a long time to break down*
    - *may be biologically magnified (they may build up in concentration as they move up through the food chain)*
    - *may be very difficult to reduce to less harmful chemicals*

Section 1: Activity 2

1. As the population of an area increases, what happens to the amount of garbage produced in that area?

   The amount of garbage produced will also increase.

2. Can you think of any ways to solve the problem of garbage disposal?

   Hopefully you said that the best way to dispose of garbage is to recycle it. Biodegradable wastes should be used to replenish the nutrients in the soil of farmland. Nonbiodegradable wastes should be recycled.

3. a. List at least four human activities that cause major changes in land use.

   - *landfills*
   - *farming*
   - *forestry*
   - *industrial and urban development*
   - *recreational use of land*

   b. For each of the ways listed, explain what kinds of changes occur in the environment.

   - *landfills: Lower land areas are filled with garbage and eventually covered with soil.*
   - *farming: Forests, grasslands, and wetlands are replaced by croplands.*
   - *forestry: Forests are often clear-cut and reseeded with a single species of trees.*
   - *industrial and urban development: Land is levelled and paved for roads or covered with buildings.*
   - *recreational use of land: Land is changed to suit the needs of recreation. This can result in changing the types of plant and animal life or restructuring the surface of the land.*

4. How would you change present land use practices in order to preserve the natural environment?

   You could change farming, forestry, industrial, urban, and recreational practices in order to preserve the natural environment.

Section 1: Activity 3

1. a. What are some of the advantages of using solar heat in your home compared to natural gas or electricity?

   Some advantages of solar heating are

   - *reduces pollution by not consuming gas or electricity*
   - *reduces the cost of heating your home (solar energy is free)*

   b. What are some of the disadvantages?

   Some disadvantages of solar heating are

   - *high initial cost of equipment and insulation*
   - *solar energy is not totally dependable (during the winter, on cloudy days, or at night)*
   - *in Alberta solar energy is at a low when you most need it (in the winter)*

2. Why are the alternative forms of energy, such as those that use solar, wind, and geothermal sources, not used extensively?

   Efficiency and high cost of equipment are the main reasons. Solar and wind energy are not dependable sources. Geothermal energy requires high input costs to drill wells and set up generating plants. Good locations for generators are often far away from the places where the energy is needed.

3. a. What are some advantages of simpler birth control methods in third world countries?

   Third world countries often contain human populations which have exceeded the limits of the environment. In these cases, a reduced population would result in fewer famines and a healthier environment. More time and money could be spent helping people achieve a higher standard of living, instead of just helping people to stay alive.

   b. Do you think the same birth control measures would be beneficial to Canada? Explain your answer.

   You might agree to the same kinds of birth control measures in order to reduce population growth. You might not agree because of your beliefs or because you feel that no outside force should influence the size of your family. Remember that people in third world countries are entitled to the same views and feelings as you.

4. What kinds of technologies could be used in third world countries to increase food production?

   They could use better farm equipment, chemicals, irrigation technology, and development of better seed and animal strains.

Section 1: Follow-up Activities

Extra Help

1. Why does the production of any product also involve the production of wastes?

   This is an interesting question. All processes, including life processes, produce wastes because the final product is different than the materials from which it was produced. (If not, then the product would already be there). Energy is usually used to produce the product and heat is often given off as waste. All of the materials which are not present in the product are removed as waste. Biological processes produce wastes which are recycled in the natural environment. Industrial processes often produce wastes which are nonbiodegradable.

2. What eventually happens to the nonbiodegradable wastes that are produced by technology?

   The nonbiodegradable wastes must be properly destroyed or disposed of in landfills or hazardous waste sites.

3. Many parts of Canada now use natural gas for heating homes. Burning natural gas produces waste products consisting mainly of carbon dioxide and water. Why is there still an environmental problem with the burning of natural gas as a fuel?

   While natural gas is one of the cleanest burning fossil fuels, the production of carbon dioxide from the combustion of natural gas increases the carbon dioxide level in the atmosphere. Since carbon dioxide is a greenhouse gas, it contributes to global warming.

4. Synthetic chemicals are often nonbiodegradable. In terms of the food chain, what happens to a nonbiodegradable chemical that is soluble in fats?

   When a chemical is fat soluble it tends to be stored in the bodies of the animals that eat it. This chemical is then passed on through the food chain, where it becomes more concentrated in higher level consumers.

5. Why is recycling a more important issue today than it was in the past?

   People today are more aware of environmental issues and problems. Recycling is one way to reduce the use of materials such as aluminum, steel, and glass. You can also conserve energy by recycling, since it takes much less energy to make steel and aluminum cans from recycled products. Recycling is also a good way to reduce the amount of garbage going to a landfill.

6. The governments of some countries have considered adopting a policy which allows only one child per married couple. Discuss one unforeseen consequence of this policy and its effects on the environment.

   One unforeseen consequence of this suggested policy is the infant death of many females. Some cultures still believe that male children will take care of their parents when the parents get old; so it is very important to have a boy when only one child is allowed. This policy sometimes leads to the aborting of female babies or making sure that female babies die soon after birth. The purpose of this policy is to achieve zero population growth and to lessen environmental impact.

Enrichment

1. What are the benefits of Clayton Askew's approach to controlling grasshoppers by using turkeys instead of insecticides?

   The benefits are reduced chemical use, reduced insect populations, better crop yields, and, of course, turkey as food. Wastes from the turkey might also function as fertilizer.

2. If this system is so good, why is it not used everywhere?

   There are some important points to consider:

   - *These turkeys were used in a garden which was fenced properly. Farmers cannot just set turkeys free in their grain fields, so that while the small garden might be insect free, the rest of the farm would still need massive amounts of insecticides to control the grasshoppers.*
   - *Turkeys are labour intensive. They have to be fed, watered, sheltered, protected from predators, and cleaned up after. Few people are willing to spend the large amount of time that is needed to look after a few turkeys.*
   - *Just because you have fifteen turkeys does not mean that fifteen turkeys will live to maturity. Disease, predation, and parasites can reduce the number of turkeys.*

3. Describe how society's needs and wants play a vital role in changing technology so that its products and wastes are less harmful to the environment.

   People need a clean, healthy environment. If the wants of a society result in technology that pollutes the environment, then this contradicts the need for an unpolluted environment. The basic need to live far outweighs any wants. Society will immediately press for technology that can satisfy its wants without polluting the environment. Sometimes technology causes pollution in distant places and does not directly affect the society that demands the products. It then becomes very difficult to make the necessary changes. A good example is the acid rain problem in Canada. Much of the pollution that causes acid rain is produced in the United States. It is very difficult to make the society in the U.S. clean up that pollution because they are not suffering the consequences. Technology and pollution do not obey geographical borders.

Section 2: Science and Technology: The Impact

This section looks in more detail at the consequences of the actions taken by society, especially when using science and technology. The student is expected to act more responsible and knowledgeable when dealing with issues related to society, science, and technology. The student will learn how to positively affect the directions that science and technology are taking.

Section 2: Activity 1

1. What were the unforeseen consequences of dumping chemical wastes that contained mercury compounds into rivers or oceans?

   No one realized that mercury compounds would be found in their seafood and poison the people who ate the seafood. Only after people were poisoned did scientists discover that the mercury compounds accumulated in the bodies of organisms and then were magnified in the food chain. It was also unforeseen that these compounds could exist in the environment for such long periods of time and spread through large bodies of water.

2. What were the unforeseen consequences of using seeds treated with methylmercury?

   Two of the most important consequences were

   - *many bird populations were drastically reduced because seed-eating birds were poisoned, and predatory birds in higher levels of the food pyramid were also affected*
   - *some people fed treated seed to their farm animals, which then poisoned the animals, the products made from them, and the people who ate the animals and products*

3. How long do you think a mercury pollution problem would last?

   This answer can vary from tens to hundreds of years. It depends on the severity of the pollution and the type of area. In some areas the pollution can be covered with sediments, in others the pollution may continue to leach into the soil or water for very long periods of time.

4. Have you heard of any cases of mercury pollution involving fish contaminated with mercury in Canada?

   There are many lakes and rivers in Canada and Alberta which are polluted with mercury. In some cases the mercury levels are so high that people are told not to eat the fish from these areas.

5. What is acid precipitation?

   Acid precipitation is any form of precipitation, like rain, snow, or sleet, which has been acidified by dissolved sulfur or nitrogen oxides.

6. Why is acid precipitation often called acid rain?

   Most of the precipitation in the populated regions of the world is in the form of rain rather than snow.

7. What is an unforeseen consequence of the highly industrialized areas of the world?

   Acid precipitation, which often falls far from the industrialized area which causes it, is one unforeseen consequence of highly industrialized areas.

8. Use the information given in the map to predict how the greenhouse effect will affect Alberta.

   a. forests:

      If Alberta becomes 30-60 percent drier, large forested areas will be replaced by grasses. Northern Alberta will look more like southern Alberta does today and southern Alberta may become a desert.

   b. farmers:

      There may no longer be enough rain to grow traditional grain crops. Farmers will have to either irrigate or plant crops which can grow to maturity on less water.

9. What are two unforeseen consequences of the burning of fossil fuels?

   Increased carbon dioxide levels in the atmosphere and the greenhouse effect are two unforeseen consequences of the burning of fossil fuels.

10. Name two greenhouse gases.

    Carbon dioxide and methane are two greenhouse gases.

11. Explain how greenhouse gases trap heat in the atmosphere.

    Greenhouse gases allow the radiation from the sun to pass through the atmosphere. When the radiation is absorbed by the Earth, it is reradiated as heat. The greenhouse gases absorb this heat (infrared radiation) and warm the atmosphere.

12. What technologies do you think are responsible for the increase in atmospheric carbon dioxide?

    Any technology which produces carbon dioxide is responsible for atmospheric carbon dioxide. Some of these are automobiles, power plants, burning fossil fuels, and deforestation involving the burning of trees.

Section 2: Activity 2

1. Describe how the advancements in the sciences and technologies related to these fields have affected your life.

   a. farming:

      There are many technologies that have improved production, such as tractors, combines, and specialized machinery. Research has produced new and better strains of crops. All of this science and technology in farming makes your life more pleasant by producing better, less expensive, and more nutritious food.

   b. industry:

      Virtually all industries use modern science and technology to produce modern products. Almost any product you use makes your life more pleasant, otherwise you would not use it.

   c. medicine:

      Virtually all medical products, such as drugs and equipment, are the result of modern science and technology. Your life is made more pleasant because most ailments and diseases can be diagnosed and treated.

2. Science is the provider of ideas which then require new technologies to make them a reality. Give one example of a scientific idea which has led to the development of new technologies.

   Almost every new technology is a result of pure science. An example is nuclear technology. Science formulated the ideas and directed the type of technology required. By harnessing nuclear reactions, scientists were able to develop technologies such as nuclear power plants and atomic bombs.

3. Technology sometimes allows for new discoveries and ideas in science. Give one example of how technology has led to new discoveries in science.

   Your answers may vary. One piece of technology that has led to new discoveries in science is the microscope. A whole world of tiny organisms was opened to science when the microscope was developed. Bacteria and other microorganisms became visible along with the cells which make up your own body.

4. Discuss the impact of nuclear technology on society.

   Nuclear technology has been a mixed blessing. The technology produces weapons with devastating effects and nuclear power plants which produce power. Nuclear power plants also produce radioactive wastes which are very difficult to handle and store. Nuclear technology is very dangerous; a single nuclear power plant accident, such as the one in Chernobyl, can make vast areas of land impossible to live in and pollute even larger areas of land. Nuclear accidents also cause widespread death, disease, and destruction.

Section 2: Activity 3

1. Give two ways to reuse each of the following items.

   a. old rubber tires: *These can be used in playgrounds, for tire bridges or swings, as planters for flowers, as bumpers for boats and wharfs, and tires can be ground up and mixed with other substances for paving roads.*

   b. books: *These can be traded, sold at garage sales and second hand stores, and given to hospitals or other charitable organizations.*

   c. steel drums: *These can be used as rain barrels, for composting, and they have been made into a musical instrument, the steel drum.*

   d. Popsicle™ sticks: *These can be used for crafts, as handles for candied apples, and as wooden coffee stir sticks.*

e. bread crusts: *These should be air-dried and then used for breadcrumbs, croutons, stuffing, bread pudding, and bird feed.*

f. old cars: *These can be used in demolition derbys, as parts for cars that are still running, and as parts for various projects. For example, an old steering wheel could be used on a go-cart or soapbox racer.*

2. List six things that you can do to reduce your impact on the environment.

There are many things that could be done to reduce your impact on the environment some examples are

- *drive your vehicle less*
- *reduce energy consumption by turning off lights and appliances when they are not in use*
- *buy items with less packaging and buy in bulk*
- *reuse everything you can, let others reuse those things that you cannot reuse*
- *recycle whenever possible*
- *buy recycled or environmentally friendly products*

3. List three things not mentioned in this activity that you can do to help the environment.

To help the environment you could

- *Reduce your water consumption. The less water you use, the less water must be processed, and the less sewage that must be returned to the environment.*

- *Never throw or dump any hazardous materials such as oil, antifreeze, or any household chemicals down the drain.*

- *Always send hazardous materials, such as paint, pesticides, and medicines, to a proper place for disposal; never take them to the dump or landfill site.*

Section 2: Follow-up Activities

Extra Help

1. What is an unforeseen consequence?

An unforeseen consequence is one that was not predicted or seen as being able to occur. Consequences are the result of an action. When you are cutting a piece of wood with a saw, one consequence is that the piece of wood will be cut. There are many other consequences to this action. The experienced carpenter knows enough to protect his eyes, to watch his hands, and to wear hearing protection and proper clothing. The inexperienced person may suffer some unforeseen consequences such as serious injuries.

2. Give two examples of unforeseen consequences resulting from the invention of the automobile.

   Air pollution, noise pollution, acid rain, the greenhouse effect, personal injury, and death are only a few unforeseen consequences of the automobile.

3. Describe one way that the science and technology of medicine has improved your life.

   There are no incorrect answers because there are so many possible ways that the science and technology of medicine helps an individual. Some possible answers might be as follows:

   - *glasses or contact lenses make it possible to see clearly*
   - *medicines which control conditions such as diabetes and high blood pressure*

4. List three ways that you can exercise control over science and technology as an individual.

   You can exercise control over science and technology in the following ways:

   - *Have your elected government control the science and technology by law. You can influence your government by writing your MP or MLA.*

   - *Buy only the products of science and technology that you can feel are good. Do not buy products that are produced by science and technology which are harmful.*

   - *Belong to an organization which can carry out your personal agenda. A larger group will exert far more pressure on the government and science and technology than an individual will.*

5. How does society as a whole control science and technology?

   Society exerts some control over science and technology by demanding (and paying for) certain products and processes. Society demanded a solution to smallpox; science and technology delivered by developing a vaccine which eliminated the disease. All countries and peoples had to cooperate to eliminate smallpox. There are many other examples of society controlling science and technology.

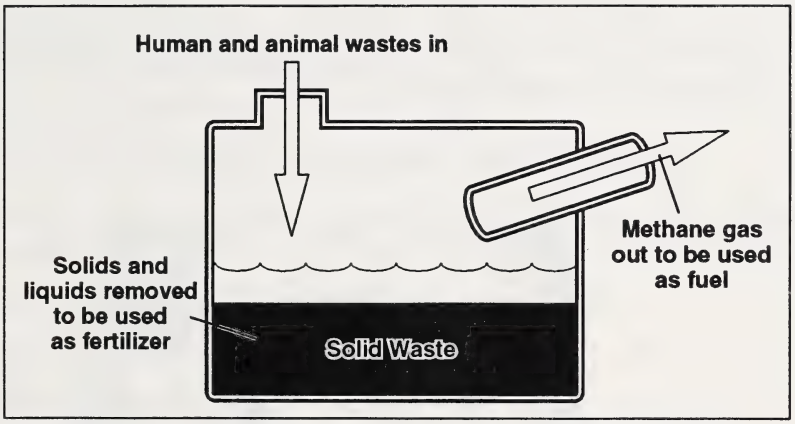
Enrichment

Research two methods that are used to treat and dispose of sewage. In each case discuss the science and technology required, the effect on the environment, and the feasibility for use in your community, in a North American city, and in a third world country.

The most common method for treating sewage is found in large North American cities. The wastes are collected, left to settle so that large particles fall to the bottom, and then skimmed to remove oils and other floating substances. The wastes may be further treated in a variety of ways involving aeration and chemicals. Less technologically advanced methods are now being researched. Some of these skim oils from the surface and run the remainder into large lagoons where natural biodegration breaks down the wastes. This process requires large areas of land since the biodegradation requires long periods of time.

Many developing countries, China in particular, use animal and human wastes to produce methane for fuel. Another byproduct of human and animal waste is fertilizer which can be used to grow better crops. This simple method is very friendly to the environment, requires little technology, and provides both fuel and fertilizer for people.

Bio-gas Production


Human and animal wastes in
Methane gas out to be used as fuel
Solids and liquids removed to be used as fertilizer
Solid Waste

Module Summary

This module has examined the effects of science, technology, and society on the environment. Some technologies cause serious environmental problems. If society continues to use those technologies because of the demand for their products, then society is responsible for minimizing the environmental damage and for pressing for less damaging technology. The student should understand that their own actions can help to clean up or lessen their impact on the environment. A culminating activity to this module could include a trip to the Alberta Special Waste Treatment Centre near Swan Hills, Alberta, a water treatment plant, or a recycling plant of some type.

Key to the Assignment Booklet

Section 1 Assignment (60 marks)

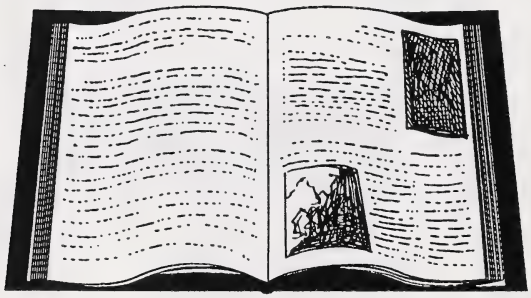
(5 marks) 1. Countries such as Britain, Canada, and the United States have spent over 200 years developing the modern technologies that they now have. Saudi Arabia has acquired the same technologies in only 40 years! How do you think Saudi Arabia was able to modernize so quickly?

Saudi Arabia began to earn money from oil production 40 years ago. Revenue from the sale of oil allowed Saudi Arabia to purchase technology from other countries. The modernization of Saudi Arabia occurred so rapidly because the country could afford to purchase the most modern products of science and technology. Saudi Arabia did not have to spend time developing the technology, just the money to purchase it.

(5 marks) 2. Often science and technology are blamed for many of the nonbiodegradable wastes that are produced. Explain how society is directly related to the production of nonbiodegradable wastes and products.

The needs of society are satisfied by science and technology being put to work to produce the required products. Society must then be ultimately responsible for the production of nonbiodegradable wastes and products.

(8 marks) 3.



a. List at least three products and three technologies that go into the making of a book.

- *pulp and paper industry*
- *printing technologies*
- *photography*
- *inks, glues, plastics, etc.*

b. What are three nonbiodegradable wastes that are produced by these technologies?

- *dioxins and chlorinated compounds used in making the paper*
- *solvents used in printing and bindery*
- *heavy metals*
- *any other reasonable answers*

(4 marks) 4. Train travel required new technologies for building tracks and bridges. List two technologies that were required for the movement of motorized vehicles such as cars, trucks, and buses.

- *roads (paved and gravel)*
- *bridges of all types*
- *signs, signals, and traffic lights*
- *radar*
- *map making*

(8 marks) 5. a. List two technologies that are involved in the manufacture of car batteries (lead-acid batteries).

- *lead mining, refining, and processing*
- *sulfuric acid production*
- *plastics industry*
- *various other possible answers such as transportation, marketing, etc.*

b. List two of the nonbiodegradable wastes or products which are produced in the making of a car battery.

- *lead and other heavy metals*
- *sulfuric acid*
- *plastics*
- *other materials are possible*

(5 marks) 6. How is population density related to the production of waste in an area?

The greater the population density, the greater the production of wastes. The lower the populations, the lower the production of waste. This is true in general, but it is important to note that this is not always the case. A more industrialized area will generate more waste in general and the waste will be more harmful waste.

(5 marks) 7. Select one situation in your province where land use by private or government groups has resulted in a conflict over the way the land is used (or misused). Why did a conflict occur?

Students' answers will vary. The most common answers will relate to the building of dams, deforestation, farming, the building of resorts, urban and industrial development, power plants, etc. The discussion of the conflict is worth four marks.

(8 marks) 8. Dichlorodiphenyltrichlorethane (DDT) is an excellent pesticide, which has been credited with preventing the spread of malaria in tropical countries.

a. Why has DDT been banned from use in Canada and the United States?

DDT has been banned in Canada and the United States because it has been found to accumulate in the body fat of living organisms. High concentrations of DDT in living tissues has been found to have serious effects.

b. Why has DDT been blamed for declining populations of eagles, hawks, and falcons.

High concentrations of DDT in birds of prey affects the thickness of their eggshells. The eggshells became very thin and many eggs break before the young can develop and hatch. High concentrations of DDT in adult birds of prey reduced their ability to reproduce, resulting in declining populations.

(6 marks) 9. There are at least forty-six developing countries which use technology that converts human and animal wastes into methane fuel and fertilizer. Explain how this simple technology will improve the quality of the environment.

Humans and animals wastes are ultimately converted into methane, carbon dioxide, and water. The methane is one of the greenhouse gases anyhow so it makes more sense to burn it and produce useful heat, carbon dioxide, and water vapour. If the methane is burned as a fuel, the demand on fossil fuels will decrease. Human and animal wastes can also be used as fertilizer. The fertilizer increases crop production and reduces the demand for commercial fertilizer produced from fossil fuels. The environment will benefit because both usages of human and animal wastes decrease the amount of fossil fuels used.

(6 marks) 10. Any technology which reduces the consumption of energy, especially fossil fuels, will improve the environment. List at least four such technologies.

The list can include any reasonable technology. Some examples are

- *wind, solar, and geothermal power plants*
- *more fuel efficient automobiles*
- *conversion to fuels that are less harmful to the environment, such as natural gas, hydrogen, and naturally produced methane*

Section 2 Assignment (40 marks)

(4 marks) 1. People who enjoy boating often own a boat and pull it from lake to lake as they travel across the country. What kinds of unforeseen consequences do you predict will occur as a result of this activity?

- *transporting undesirable plants and animals from one lake to another*
- *transferring plant and animal diseases from lake to lake*

This is usually accomplished without the boaters' knowledge. Plants, animals, eggs, and disease spores become trapped in the boat, motor, and trailer and are then deposited in the next lake.

(5 marks) 2. Many environmental groups have protested against nuclear power plants. The consequences of these plants have been understood ever since the effects of nuclear weapons were demonstrated. The Chernobyl nuclear disaster in the Ukraine clearly demonstrated the consequences of an accident occurring. Some of the consequences of the nuclear accident were many people were killed trying to put out the fires at the power plant, thousands of people were exposed to radiation and many will die from cancer, and large areas of farming land were contaminated by radioactive fallout. Explain why nuclear power plants are still being built and used, given the serious consequences that they present.

The power and economical benefits that society demands are important. These benefits are deemed to offset the risks of nuclear power. There are many examples of this scenario in which the risks are very high but are deemed worthwhile. One could easily look at individual risks that are taken by one individual but not by another. Sky diving, mountain climbing, and bungee jumping are all such examples. Accept any reasonable answer which weighs risks and consequences.

(5 marks) 3. Modern society and medicine are grappling with the problem of sustaining life. Medicine and machines can keep a person living for many years even though that person may be brain dead or otherwise completely disabled. Medicine believes that life should be sustained as long as science and technology allow. Some segments of society have a different view; a human should be allowed to die with dignity under certain circumstances, for example, when a person is brain dead. Assume that science and technology have progressed to the point where a human being can be kept alive indefinitely. Discuss the impact on society that this scientific and technological advance would have.

This concept is a common social nightmare. It is easy to see where it is impossible to resolve the issue of indefinite life. The impact on society is serious. Do only the wealthy and powerful get to live? Would the world become overpopulated? Actually every social problem today would be magnified by such a development. Accept any reasonable discussion.

(7 marks) 4. Clear-cut logging involves science, technology, and society. What are some of the unforeseen consequences of clear-cut logging? Why were these consequences not predicted, and why is the practice allowed to continue once these consequences become visible?

Some unforeseen consequences are erosion, slow regeneration of forests, destruction of animal habitats, acceleration of the greenhouse effect, pollution of water, disruption of the water cycle, spawning streams being ruined, pollution from the pulp and paper mills, etc. Society demands that products be produced at the lowest possible price. Society also demands the jobs and economic prosperity that industry provides.

(4 marks) 5. Electronic technology has made a major impact on modern society. Discuss some of the ways that computer technology has affected your life.

Answers will vary. Computer technology has affected virtually every aspect of modern society. Education, industry, finance, communication, defence, home appliances, autos, and medicine are all deeply involved in computer technology. The impact has been an improved standard of living.

(9 marks) 6. "If you are not part of the solution, you are part of the problem." Discuss this statement with respect to

a. your impact on the environment through the products, science, and technology that you use

The products you use involve pollution of the environment due to wastes from the production, use, and disposal of the products. The student can discuss any specific or general products and relate their uses to being part of the problem. They can also discuss how reduced use of the product is part of the solution.

b. your impact on science and technology through political and consumer pressure

You can control, to some degree, the kinds of science and technology that are used by voting for politicians that will carry out your specific agenda, writing to politicians who are presently in office and not following your agenda, and being a member of lobby groups which collectively place pressure on industry and government. As a consumer of products, you can exert pressure on business and industry when you buy environmentally friendly products and refuse to buy those products which adversely affect the environment. This consumer pressure can improve the science and technology used to produce products so that the environment is protected. The general emphasis should be that if, as an individual or as a member of society, you do not become involved, you are actually contributing to the problem.

(6 marks) 7. This modern society has witnessed some incredible ecological disasters: massive oil spills, the incredible pollution from the oil well fires in Kuwait, destruction of the rain forests, acid rain, and the Chernobyl nuclear disaster, to name just a few. Why do these disasters continue to occur?

There should be some discussion of political instability, the variety of standards between countries, human incompetence, greed, and disparity between the rich and poor, and disparity between the races.

This is a course designed in a new distance-learning format, so we are interested in your responses. Your constructive comments will be greatly appreciated so that a future revision may incorporate any necessary improvements.

TEACHER QUESTIONNAIRE FOR SCIENCE 14

Teacher's Name _____ Teacher's area of expertise _____

School Name _____ Date _____

Design

1. The modules follow a definite systematic design. Did you find it easy to follow?

   ❑ Yes ❑ No If no, explain.

   _____

   _____

2. Did your observations reveal that the students found the design easy to follow?

   ❑ Yes ❑ No If no, explain.

   _____

   _____

3. Did you find the Learning Facilitator's Manual helpful?

   ❑ Yes ❑ No If no, explain.

   _____

   _____

4. Part of the design involves stating the objectives in student terms. Do you feel this helped the students understand what they were going to learn?

   ❑ Yes ❑ No If no, explain.

   _____

   _____

5. The questions in the Module Booklet are to help clarify and reinforce the instructional materials. The answers were placed in the Learning Facilitator's Manual. Did this design prove helpful?

❑ Yes ❑ No If no, explain.

_____

_____

6. Did the Follow-up Activities prove to be helpful?

❑ Yes ❑ No If no, explain.

_____

_____

7. Were students motivated to try these Follow-up Activities?

❑ Yes ❑ No If no, give details.

_____

_____

8. Suggestions for video activities are included in the Learning Facilitator's Manual. Were you able to use these activities?

❑ Yes ❑ No Comment on the lines below.

_____

_____

9. Were the assignments appropriate?

❑ Yes ❑ No If no, give details.

_____

_____

10. Did you fax assignments?

❑ Yes ❑ No

11. If you did fax, did you get satisfactory results from using this procedure?

❑ Yes ❑ No If no, give details.

_____

_____

Instruction

1. Did you find the instruction clear?

❑ Yes ❑ No If no, give details.

_____

_____

2. Did your observations reveal that the students found the instruction interesting?

❑ Yes ❑ No If no, give details.

_____

_____

3. Did you find the instruction adequate?

❑ Yes ❑ No If no, give details.

_____

_____

4. Was the reading level appropriate?

❑ Yes ❑ No If no, give details.

_____

_____

5. Was the work load adequate?

❑ Yes ❑ No If no, give details.

_____

_____

6. Was the content accurate and current?

❑ Yes ❑ No If no, give details.

_____

_____

7. Did the content flow consistently and logically?

❑ Yes ❑ No If no, give details.

_____

_____

8 Was the transition between booklets smooth?

❑ Yes ❑ No If no, give details.

_____

_____

9. Was the transition between print and media smooth?

❑ Yes ❑ No If no, give details.

_____

_____

Additional Comments

_____

_____

_____

_____

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_____

_____

When you have completed this questionnaire, please mail it to the following address.

Design Department
Alberta Distance Learning Centre
Box 4000
Barrhead, Alberta
T0G 2P0

N.L.C. - B.N.C.
3 3286 11541027 2

This booklet cannot be purchased separately; the
Learning Facilitator's Manual is available
only as a complete set.

Science 14

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